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Improving Outcome Prediction Accuracy of Carotid Endarterectomy (CEA) in Asymptomatic Patients Using a Novel Frailty Risk Score (FRS)◇

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Objectives: CEA in asymptomatic patients is recommended only when postoperative complications and mortality are kept low; but predicting CEA complications in a specific patient remains elusive. To better predict 30-day postoperative outcomes, we calculated a novel point-weight ordinal Frailty Risk Score (FRS) by an analysis of 20 preoperative risk factors based on their individual odds ratios (ORs) as predictors of postoperative complications using all vascular surgery cases in the 2005 to 2011 American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database (n = 121,015).

Methods: To compare the predictive value of this calculated FRS with that of patient demographics and surgical variables alone, we examined the predictive contribution value of five levels of FRS on four outcomes (stroke, myocardial infarction [MI], and mortality), and a composite of the three outcomes in all primary asymptomatic CEAs in the 2005 to 2011 ACS-NSQIP database (n = 39,859).

Results: Thirty-day mortality occurred in 273 patients (0.7%), stroke in 527 (1.3%), MI in 301 (0.8%), and the composite outcome was positive in 1008 (2.5%). We found that by itself, the FRS level was strongly and significantly associated with all four outcomes (Table). For stroke, we used only three levels of frailty because the stroke rate no longer increased after this point, and found that for the lowest vs highest frailty levels, the rate of stroke was 1.1% vs 2.4% ($P < .0001$). Percentage of patients that were positive for the composite outcome was 1.7% in lowest vs 15.2% in the highest FRS group ($P < .0001$).

Conclusions: An easy-to-calculate FRS can help stratify risk based on preoperative patient characteristics and will help to identify asymptomatic patients for whom CEA is risky.

Table. Percentage of patients positive for each outcome by frailty level

Frailty level	*Death, % (95% CI)*	*Stroke, % (95% CI)*	*MI, % (95% CI)*	*Composite outcome, % (95% CI)*
1	0.2 (0.2-0.3)	0.2 (0.2-0.3)	0.4 (0.3-0.5)	1.7 (1.5-1.9)
2	0.7 (0.6-0.9)	1.3 (1.2-1.5)	0.8 (0.7-0.9)	2.6 (2.4-2.8)
3	1.6 (1.2-2.0)	2.4 (1.9-2.9)	1.7 (1.3-2.1)	5.1 (4.4-5.8)
4	3.0 (1.7-4.4)	1.6 (0.6-2.6)	2.2 (1.1-3.4)	6.4 (4.5. 8.3)
5	10.7 (5.0-16.4)	1.8 (0-4.2)	5.4 (1.2-9.5)	15.2 (8.5-21.8)

CI, Confidence interval; *MI*, myocardial infarction.

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Development of a Successful Follow-Up Program for Patients After Endovascular Aneurysm Repair†

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Objectives: Patients treated with endovascular abdominal aortic aneurysm (AAA) repair (EVAR) require lifelong follow-up. Although a variety of post-EVAR surveillance protocols have been suggested, adherence to follow-up outside of industry-funded clinical trials has been challenging. We aim to describe an effective system for EVAR surveillance over 10 years that results in exceptional follow-up.

Methods: From 2003 to 2013, 225 EVARs were performed for elective, symptomatic, or ruptured AAA using a variety of commercially available devices at a single, rural, academic center. After repair, all patients were followed up every 6 to 12 months with clinic visits and imaging (computed tomography or ultrasound). All patients were entered into the Vascular Quality Initiative database, which was audited quarterly by hospital quality personnel. At the time of the audit, a list of EVAR patients due for imaging was generated and forwarded to a dedicated vascular clinic nurse who arranged imaging and clinic visits for those missing follow-up. Mortality and rationale for incomplete follow-up were recorded in a prospective follow-up database.

Results: In hospital mortality was 0.9% for elective or symptomatic AAA and 25% for ruptured AAA. Most (99%) were discharged to home and 98% remained independent at 1 year. All-cause mortality was 7.2%, 25.4%, 44.9%, and 68.1% at 1, 3, 5, and 10 years. Median follow-up was 3.7 years. Using the above protocol resulted in comprehensive follow-up of patients at 1, 3, and 5 years of 96%, 92%, and 84%, respectively. A significant drop off in adherence to follow-up was noted at 9 years. Resources required to accomplish this were minimal, with <0.05 nursing full-time equivalents and <0.05 full-time equivalents for hospital quality personnel (Fig).

Conclusions: EVAR has acknowledged rates of short-term and long-term failure so that implantation of the stent graft is only part of successful treatment of AAA. The follow-up program we describe is comparable to that achieved in industry-sponsored trials. With many groups currently participating in the Vascular Quality Initiative, the methodology presented here is reproducible.

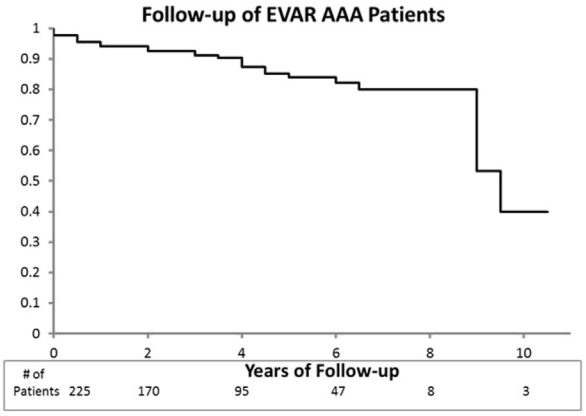

Fig. Follow-up of endovascular abdominal aortic aneurysm (*AAA*) repair (*EVAR*) patients.

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Venous Thromboembolism in High-Risk Patients: Are We Doing Enough for Prevention?◇

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Objectives: Hospital-acquired venous thromboembolism (VTE) is a costly quality and safety indicator thought to be preventable. Embedding risk-assessment models into the electronic medical record (EMR) to increase appropriate use of VTE prophylaxis for low-risk, medium-risk, and high-risk patients is one strategy to decrease VTE events. We proposed that high-risk patients receiving prophylaxis with mechanical and pharmacologic methods would have a lower VTE rate than those who received one prophylactic modality or none.

Methods: All medical and surgical patients admitted from October 1, 2011, to October 31, 2012 were reviewed. The EMR was reviewed for the VTE risk-assessment score determined upon admission, the type of VTE prophylaxis used, and the rate of hospital-acquired VTE by risk category.

Results: Of the 24,960 patients admitted, 175 (0.71%) developed VTE during their hospital stay. At the time of admission, 16.7% (4164) were assigned to the high-risk group, of which 71.3% (2967) received mechanical and pharmacologic prophylaxis, 13.0% (542) mechanical alone,

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2.1% (86) pharmacologic alone, and 13.7% (569) no prophylaxis. The incidence of VTE in the high-risk group was 1.3% (54) compared with 0.9% (88) and 0.2% (16) in the medium-risk and low-risk groups, respectively. Of the 54 high-risk patients who developed VTE, 48 (88%) received appropriate prophylaxis as assigned by the risk-assessment model. The incidence of VTE in the high-risk group was greater when mechanical and pharmacologic prophylaxis were both used (50.0%) compared with pharmacologic alone (3.7%), mechanical alone (35.2%), or no prophylaxis (11.1%; $P = .05$; Fig).

Conclusions: Hospital-acquired VTE develops in high-risk patients despite appropriate risk assessment, identification, and prophylaxis with pharmacologic and mechanical methods. Further consideration for more aggressive prophylaxis should be given to this high-risk patient population for VTE prevention.

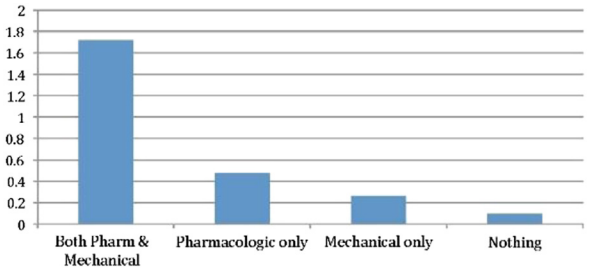

Fig. Incidence of venous thromboembolism (VTE) in all patients based on prophylaxis.

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Prospective Cost Analysis and Implications of Wound Complications in Lower Extremity Vascular Surgery Procedures†

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Objectives: Wound complications (WCs), such as surgical site infection, wound dehiscence, hematoma, and seroma after surgery cause significant morbidity and require additional resources to treat. We sought to quantify the marginal cost of WCs in patients undergoing open lower extremity vascular procedures.

Methods: Hospital administrative accounting cost data from a single tertiary institution were analyzed in patients enrolled in a prospective, randomized trial testing two postoperative wound dressings (gauze vs silver-coated alginate). A Wilcoxon rank sum test was used to assess the incremental cost of WCs at 30 days.

Results: Of the 224 patients who underwent lower extremity vascular surgery procedures, 61 (27.2%) developed WC, 40 (17.9%) of which were a surgical site infection. The mean incremental cost of WCs was $11,973, reflecting a 35% higher cost than non-WC patients ($P = .0112$). Patients with WCs had a longer mean index length of stay (8.2 vs 6.0 days, $P = .0025$), a higher rate of 30-day readmissions (23% vs 6%, $P = .0001$), and a greater mean cumulative 30-day length of stay (10.1 vs 6.2 days, $P = .0001$). The tested dressings showed no efficacy or cost differences.

Conclusions: WCs remain a frequent sequela of open lower extremity vascular surgery, with significant cost and resource utilization. Although the tested dressing did not demonstrate efficacy in reducing WCs, there remains potential cost savings for new and effective products or patient care quality improvements to capture.

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Chronic Mesenteric Ischemia: Outcome Analysis and Predictors of Endovascular Failure†

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Objectives: Outcomes of open (OR) and endovascular revascularization (ER) for chronic mesenteric ischemia (CMI) were analyzed to identify predictors of endovascular failure.

Methods: A multicenter, retrospective study was performed of all consecutive patients with CMI (151 patients/254 vessels) treated from 2008 to 2012. Demographics, comorbidities, etiology, and treatment modalities were compared. Outcomes included technical success, restenosis requiring reintervention, complications, mortality, and hospital length of stay (LOS).

Results: A total of 126 patients were treated with ER (83%) and 25 patients with OR (17%). Average follow-up period was 15.5 months. Overall mortality was 4.6% (7 of 151). A comparison between the two groups is reported in the Table. Among patients treated with ER, 14.3% developed technical and perfusion-related complications vs 20% in the OR group ($P = .464$). A subgroup analysis showed patients with ER requiring reinterventions had a higher incidence of long lesions >2 cm on angiography (55% vs 7%, $P < .05$). Patients crossing over from ER to OR had a significantly higher mortality compared with ER group-only (17.6% [3 of 17] vs 2.5% [3 of 119]), $P = .007$).

Conclusions: ER has similar mortality and shorter hospitalization but higher rate of restenosis requiring reintervention compared with OR. Patients with ER who require reintervention appear to have longer lesions on angiography. Patients who crossed over from ER had a higher mortality than primary OR or ER patients. These findings may guide treatment selection in patients with CMI undergoing ER or OR.

Table. Comparison of patients treated with endovascular revascularization (ER) and patients treated with open revascularization (OR)

Variable	*ER*	*OR*	P
Age, mean years	73 ± 8	64 ± 11	.0003
Comorbidities, %	62	38	.0026
Vessels treated	1.23 ± 0.42	1.59 ± 0.5	.0032
Restenosis, %	25	4	.029
Hospital LOS, days	5 ± 6	13 ± 10	.012
Mortality, %	4.8	4	.868

LOS, Length of stay.

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Comparison of Risk Factors for Length of Stay and Readmission Following Lower Extremity Revascularization◇

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Objectives: Recent initiatives have created incentives to reduce length of stay (LOS) and decrease readmission rates. We sought to elucidate the risk factors for both outcomes and to clarify the relationship between them in patients undergoing lower extremity bypass (LEB).

Methods: Peripheral arterial disease patients (PAD) who underwent LEB were identified from the 2007 to 2010 California State Inpatient Database. Logarithmically transformed LOS and risk factors were analyzed using linear regression. Risk factors for 30-day readmission were analyzed using logistic regression.

Results: Of 6558 patients who underwent LEB, 1541(24%) were readmitted. The average index LOS was 8.3 days for those who were

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